(19)日本国特許庁(JP)　(12)公表特許公報(A)　(11)特許出願公表番号
特表2004-510371
(P2004-510371A)
(43)公表日　平成16年4月2日(2004.4.2)

(51)Int.Cl.[7]	F I		テーマコード（参考）
H04L 29/06	H04L 13/00	305C	5K030
H04L 12/56	H04L 12/56	400Z	5K034

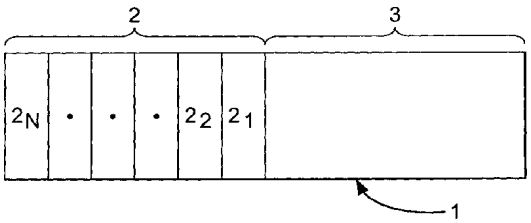
審査請求 未請求　予備審査請求 有　（全 62 頁）

(21)出願番号	特願2002-531238(P2002-531238)
(86)(22)出願日	平成13年9月26日(2001.9.26)
(85)翻訳文提出日	平成15年3月28日(2003.3.28)
(86)国際出願番号	PCT/GB2001/004308
(87)国際公開番号	WO2002/026860
(87)国際公開日	平成14年4月4日(2002.4.4)
(31)優先権主張番号	0023766.9
(32)優先日	平成12年9月28日(2000.9.28)
(33)優先権主張国	イギリス(GB)
(31)優先権主張番号	0102158.3
(32)優先日	平成13年1月29日(2001.1.29)
(33)優先権主張国	イギリス(GB)

(71)出願人　500519507
ローク　マナー　リサーチ　リミテッド
イギリス国　エスオー５１　０ゼットエヌ　ハンプシャー　ロムジー　オールド・ソルズベリー・レーン
(74)代理人　100088454
弁理士　加藤　紘一郎
(72)発明者　マッカン，ステファン
イギリス国　ハンプシャー　エスオー１６　８ディーエス　サザンプトン　ロウンハムズ　ジェフリーズ・クロウス　１
(72)発明者　ウエスト，マーク
イギリス国　ハンプシャー　エスオー５２　９エヌティー　サザンプトン　ノース・バデズリー　ラングハム・クロウス　５
最終頁に続く

(54)【発明の名称】データパケットの処理方法

(57)【要約】
通信システムにおけるデータ流のデータパケット処理方法。この方法では、データ流からの複数のデータパケットを分析して、複数のデータパケットのうち各パケットの１またはそれ以上の部分がデータパケット間で如何に変化するかを示すプロフィールデータを発生させる。このプロフィールデータは、そのデータに適したデータパケット圧縮方式を通信システムのデータパケットに対して実行できるように利用可能な状態にされる。



【特許請求の範囲】
【請求項１】
通信システムにおけるデータ流のデータパケットを処理する方法であって、
データ流から複数のデータパケットを受け、
複数のデータパケットを分析し、
分析に応答して、複数のデータパケットのうち各パケットの１またはそれ以上の部分がデータパケット間で如何に変化するかを示すプロフィールデータを発生し、
データ流のデータパケットに対してプロフィールデータに適したデータパケット圧縮方式を実行できるようにそのプロフィールデータを利用可能な状態にするステップより成るデータパケットの処理方法。
【請求項２】
プロフィールデータを、通信システムにおけるデータ流のデータパケットに対して圧縮方式を実行する圧縮器へ送るステップをさらに含む請求項１の方法。
【請求項３】
プロフィールデータはネットワークリンクを介して圧縮器へ送られる請求項２の方法。
【請求項４】
データ流のパケットに対してデータパケット圧縮方式と相補的なデータパケット圧縮解除方式を実行できるようにプロフィールデータを利用可能な状態にするステップをさらに含む請求項２または３の方法。
【請求項５】
圧縮器により圧縮されたデータ流のパケットを圧縮解除するために圧縮解除方式を実行する圧縮解除器へプロフィールデータを送るステップを含む請求項４の方法。
【請求項６】
プロフィールデータはネットワークリンクを介して圧縮解除器へ送られる請求項５の方法。
【請求項７】
プロフィールデータは無線インターフェイスを介して圧縮解除器へ送られる請求項６の方法。
【請求項８】
プロフィールデータは、一連のビットとして符号化されデータパケットに付着されて、圧縮解除器へ送られる請求項６または７の方法。
【請求項９】
複数のパケットは、プロフィールデータがパケットの１またはそれ以上のフレームがパケット間で如何に変化するかを示すように分析される上記請求項のうちの任意の請求項の方法。
【請求項１０】
１またはそれ以上のフレームはヘッダーフレームである請求項９の方法。
【請求項１１】
複数のパケットは、プロフィールデータが、各パケットの所定数ビット長の１またはそれ以上のサブセクションがパケット間で如何に変化するかを示すように分析される請求項１乃至８のうちの任意の請求項の方法。
【請求項１２】
プロセッサー上で実行されると請求項１の方法を実行するコンピュータープログラム。
【請求項１３】
通信システムにおけるデータパケットの処理装置であって、
複数のデータパケットを受ける手段と、
複数のデータパケットを分析する手段と、
分析に応答して、複数のデータパケットのうち各パケットの１またはそれ以上の部分がデータパケット間で如何に変化するかを示すプロフィールデータを発生する手段と、
データ流のデータパケットに対してプロフィールデータに適したデータパケット圧縮方式

を実行できるようにそのプロフィールデータを利用可能な状態にする手段とより成るデータパケット処理装置。
【請求項１４】
通信ネットワークにおけるデータ流のデータパケット処理システムであって、
データ流の複数のデータパケットを受け、
複数のデータパケットを分析して複数のデータパケットのうち各パケットの少なくとも一部がパケット間で如何なる挙動を示すかを表す挙動データを発生し、
データ流のデータパケットの挙動データに応じてデータパケット圧縮方式を実行するステップより成るデータパケット処理システム。
【発明の詳細な説明】
【０００１】
本発明は、データパケットの処理方法に関する。
【０００２】
多くのデジタル通信ネットワークにおいて、データは、通常、パケットと呼ぶ可変サイズの個別部分に区分けした形で送信局から受信局へ送信される。ネットワークの１つの局から別の局へデータパケットを送るための手順、また送信局及び受信局でパケットを如何に処理するかを決める手順を規定する種々の通信プロトコルが開発されている。通信を行うためにプロトコルが実行しなければならない機能が多数あるが、それらの機能は実際上あまりにも多いため、各々が通信の１またはそれ以上の特定の局面を取扱うプロトコルのセットが使用される。恐らく、最もよく知られているプロトコルのセットは通信制御プロトコル／インターネットプロトコル（ＴＣＰ／ＩＰ）であるが、これはインターネットで広く使用されている。
【０００３】
図１は、単純なパケット１の概略図である。全てのパケットに共通であるように、パケット１は、ヘッダー２（プロトコル制御情報ＰＣＩとしても知られる）と、ペイロード３（受信ノードへ送られる実際のデータ）との２つの部分より構成されると考えることができる。ヘッダー２は、2_1乃至2_Nで示す多数のフィールドより成り、各フィールドはその通信にとって重要な情報を含んでいる。ヘッダーを構成するフィールドを例示すると、送信局のアドレスを示す「ソースフィールド」、受信局のアドレスを示す「デスティネーションフィールド」、ペイロードのサイズを示す「データ量フィールド」及びパケットの時系列番号を示す「識別フィールド」がある。他に多くの種類のフィールドがあるが、これらは当業者に知られている。
【０００４】
特定のパケットに関連するプロトコルセットはパケットのペイロード部分により運ばれるデータを規定せず、例えば、ヘッダーに存在するフィールドの種々のタイプ、フィールドの長さ及び順番及びフィールドを構成するビットパターンの解釈方式のようなヘッダーのフォーマットを特定する。
【０００５】
移動体通信ネットワーク及びインターネットは、それらの機能の点で見ると収斂しつつある。いわゆる第３世代（３Ｇ）携帯電話にとって、インターネットデータのパケットを直接取扱えること、またユーザーが継ぎ目のない電子メール、ブラウザーによるウェブの検索、マルチメディア及び他のサービスにアクセスできることが望ましい。ＴＣＰ／ＩＰのようなプロトコルは、主として、無線ネットワークで利用できる帯域幅よりも帯域幅が比較的大きい固定ネットワークを対象として設計されている。音声を運ぶために使用する場合、パケットヘッダーによるメッセージのオーバーヘッドはネットワーク全容量の最大７５％を占めることがあり、これは移動体通信ネットワークにとっては受け入れることができない。
【０００６】
この問題を軽減するために、無線インターフェイスを介してパケットを送信する前にパケットヘッダーを圧縮する種々の圧縮方式が開発されている。かかる方式の一例としてよく

知られたものに、「ＲＦＣ１１４４」に記載されたバン・ジェイコブソン方式がある。
【０００７】
以前のヘッダー圧縮方式では、ヘッダーの圧縮を実行するエンティティと、後で圧縮解除するエンティティとは、彼らが取扱う必要があると予想される公知のプロトコルスタックの任意のものに関連するパケットのヘッダープロフィールを記憶した記録にアクセスするように予め構成されている。
【０００８】
ヘッダープロフィールは実際、ヘッダーの各特定フィールドの値がパケット間で如何に変化するかまたは如何なる挙動を示すかを表すものである。例えば、概念プロトコルスタックＺに関連する単純なヘッダーは３つのフィールドＡ、Ｂ、Ｃより成るが、そのプロフィールは、フィールドＡ＝静的、フィールドＢ＝不規則、フィールドＣ＝線形であって、フィールドＡの値はパケット間で変化せず、フィールドＢの値はパケット間でランダムに変化し、フィールドＣの値はパケット間で線形変化することを意味することがある。
【０００９】
ヘッダープロフィールにアクセスすると、圧縮器及びそれに関連する圧縮解除器は使用中の特定のプロトコルセットについて最適化された圧縮方式及びそれに続く圧縮解除方式を実行できる。例えば、ヘッダーが概念プロトコルスタックＺにより規定されたパケットを受信すると、圧縮器は、プロトコルスタックＺに関連するヘッダープロフィールが分かっているため、各パケットにつきフィールドＡが静的フィールド符号化により圧縮され、フィールドＢが不規則フィールド符号化により圧縮され、フィールドＣが線形フィールド符号化により圧縮される圧縮方式を実行できる。同様に、圧縮解除器は、ヘッダープロフィールを知っているため最適化された圧縮解除方式を実行できる。
【００１０】
公知のヘッダー圧縮／圧縮解除システムにとって、ヘッダーが新しいプロトコルスタック（または恐らく旧いプロトコルスタックのバリエーション）により規定されるため新しいタイプのパケットデータを初めて取扱うようになることはありそうなことである。これを実行するために、システムがアクセスするヘッダープロフィールの記録を、まず第１に新しいプロトコルスタックに関連するヘッダープロフィールにより更新しなければならない。
【００１１】
ネットワーク管理者がプロフィールの更新を行えるネットワーク基地局間の通信では、これはわずらわしいことであるが、不可能ではない。しかしながら、例えば、携帯電話のような移動体通信では容易でない。
【００１２】
本発明は、上述した問題を解消または軽減することを目的とする。
【００１３】
本発明によると、通信システムにおけるデータ流のデータパケットを処理する方法であって、データ流から複数のデータパケットを受け、複数のデータパケットを分析し、分析に応答して、複数のデータパケットのうち各パケットの１またはそれ以上の部分がデータパケット間で如何に変化するかを示すプロフィールデータを発生し、データ流のデータパケットに対してプロフィールデータに適したデータパケット圧縮方式を実行できるようにそのプロフィールデータを利用可能な状態にするステップより成るデータパケットの処理方法が提供される。
【００１４】
本発明によるとまた、通信システムにおけるデータパケットの処理装置であって、複数のデータパケットを受ける手段と、複数のデータパケットを分析する手段と、分析に応答して、複数のデータパケットのうち各パケットの１またはそれ以上の部分がデータパケット間で如何に変化するかを示すプロフィールデータを発生する手段と、データ流のデータパケットに対してプロフィールデータに適したデータパケット圧縮方式を実行できるようにそのプロフィールデータを利用可能な状態にする手段とより成るデータパケット処理装置

が提供される。
【００１５】
本発明によるとまた、通信ネットワークにおけるデータ流のデータパケット処理システムであって、データ流の複数のデータパケットを受け、複数のデータパケットを分析して複数のデータパケットのうち各パケットの少なくとも一部がパケット間で如何なる挙動を示すかを表す挙動データを発生し、データ流のデータパケットの挙動データに応じてデータパケット圧縮方式を実行するステップより成るデータパケット処理システムが提供される。
【００１６】
図２を参照して、該図は本発明によるシステムを示す。このシステムは、少なくとも１つの基地局１１がカバーエリア内にある少なくとも１つの移動局または携帯電話１２と通信するセルラー移動体通信ネットワーク１０より成る。移動体通信ネットワーク１０は、例えば、ＧＳＭネットワークまたはＵＭＴＳネットワークである。かかるネットワークを構成するコンポーネントとして、例えば、移動局、基地局、基地局コントローラー、ゲートウェイ及び基地局と移動局の間の通信を可能にし、移動体通信ネットワークを他の通信ネットワーク、例えば、ＰＳＴＮまたはインターネットに接続するコンポーネントがあるが、その構造及び機能は当業者にとってよく知られているため、ここでは詳述しない。
【００１７】
さらに、当業者にはよく知られているように、移動局は、インターネットのようなデータネットワークかまたはそのネットワークを介して動作する移動体通信ネットワークへ送られるデータを取扱えるようにするハードウェア／ソフトウェアを組み込んでいる。データは、例えば、音声、ビデオ及びテキストデータ並びにウェブページを含む多くの形式のものである。
【００１８】
図２に示す実施例において、移動局１２は、インターネット１４から移動通信ネットワーク１０へ送られるパケットデータを、基地局１１から無線インターフェイス１３を介して受信する。基地局１１には、無線インターフェイス１３を介して送信する前に、受信したパケットを圧縮する圧縮器１５が設けられている。この圧縮器１５は主としてパケットヘッダーを圧縮するものであるが、パケットのペイロードを圧縮することもできる。
【００１９】
圧縮器１５は、全ての基地局１１において蓄積されたプログラムを有するが、このプログラムは、基地局のプロセッサー（図示せず）により実行されると、移動局１２への送信前に受信パケットを圧縮する。導入部分に述べたように、パケット圧縮用の適当な圧縮アルゴリズムは当業者によく知られている。
【００２０】
これに対応して、移動局１２には、基地局１１からの圧縮パケットを圧縮解除するための圧縮解除器１６が設けられている。圧縮解除器１６は、全ての移動局１２において蓄積されたプログラムを有するが、このプログラムは、移動局１２のプロセッサー（図示せず）上で実行されるとパケットを圧縮解除する。パケット圧縮解除用の圧縮解除アルゴリズムは当業者によく知られている。
【００２１】
基地局１１にはさらに、以下において便宜的に「プロファイラー」と呼ぶエンティティ１７が設けられている。このプロファイラー１７は、基地局１１に蓄積されその基地局１１のプロセッサー（図示せず）上で実行されるソフトウェアを有する。プロファイラー１７の機能は、移動局１２宛のパケット流中のパケットを分析して、種々のパケットの対応ビットの時系列の値がパケット間で如何に変化するかを示すプロフィールまたはパターンを突き止めることである。プロファイラー１７は、かかる挙動パターンを突き止めると、この情報を圧縮器１５と圧縮解除器１６の両方に送って、これらのエンティティがデータパケットについて最適な圧縮／圧縮解除方式を実行できるようにする。従って、以前のシステムとは異なり、圧縮器１５及び圧縮解除器１６は、パケットの圧縮及びそれに続く圧縮

解除を行えるようにするための所与のパケット流中のパケットプロフィールに関する情報を先天的に持つ必要がないため、任意のパケット流を取扱うことができる。

【００２２】

図２だけでなく図３を参照すると、本発明の実施例に用いるプロセスの一例が記載されている。この例において、各パケットのフィールドの数、それらの順番及び各フィールドの長さは、各接続開始時に圧縮器１５に知られている。しかしながら、パケット間の対応フィールドの挙動については知られておらず、プロファイラー１７がこれを突き止める。

【００２３】

ステップ２０において、データパケットが基地局１１に到達し始めると、プロファイラー１７は、ステップ２１において、パケット間で対応フィールドの値がどのように相違するかを突き止めるためにパケットの分析を開始する。ステップ２２において、プロファイラーは、パケットの少なくとも１つのフィールドの挙動を突き止めるに十分な数のパケットを分析し、ステップ２３において、この情報を圧縮器１５及び圧縮解除器１６へ送る。ステップ２４において、プロファイラー１７は、パケットが到着次第それらを継続して分析することによりさらに多くのフィールドの挙動を突き止め、１つのフィールドの挙動を識別する度にこの情報を圧縮器１５と圧縮解除器１６へ送る（ステップ２５）。ステップ２６では、プロファイラー１７が最終的に受信したパケットの完全なプロフィールを形成するまで、換言すれば、パケットの各フィールドの挙動パターンについての情報が得られるまで、このプロセスが継続する。

【００２４】

図４は、パケットプロフィールの概念を示すものである。パケットの各フィールドについて、プロフィールは、フィールドのサイズ及びフィールドがパケット間で如何に変化するかを表す。上述した例では、圧縮器は各フィールドのサイズについての予備知識を備えているため、プロファイラー１７は各フィールドの挙動を突き止めるだけでよい。

【００２５】

基地局１１で受信されるパケットは多数のフィールドを有するが、これらのフィールドは、コール接続時間の間静的であるか、接続時間の間、例えば線形のような予測可能な態様で変化するか、または接続時間の間に不規則な変化をするかである。プロファイラー１７が所与のフィールドの挙動について圧縮器１５へ通告する度に、圧縮器１５は、後続のパケットのそのフィールドに対して適当な圧縮方式を実行することができる。例えば、パケット間で変化が観察されないフィールドは、移動局１２へ送られるその後の圧縮パケットから省略することが可能であり、例えば、線形変化が観察されるフィールドは線形変化するフィールドに適した方式により圧縮することができる。各タイプのフィールドの挙動にとって適当な圧縮方式は当業者に知られている。圧縮解除器１６へ所与のフィールドの挙動を通告することにより、圧縮解除器は圧縮パケットのそのフィールドに対して相補的な圧縮解除方式を実行することができる。

【００２６】

接続開始時には、圧縮器１５は、パケットの任意のフィールドの挙動に対する情報を所有しない。従って、最初は、非圧縮状態のパケットが移動局１２へ送られる。フィールドの挙動に関する情報をプロファイラー１７が形成するにつれて圧縮器１５はそれらのパケットに対し圧縮を開始するが、これは最初は非常に保守的な方式である。この方式は、圧縮器１５がプロファイラー１７からさらに多くの情報を受けるにつれて改善されるため、圧縮器１５は１またはそれ以上の種々のフィールドに適した圧縮方式を実行することができる。

【００２７】

基地局１１と移動局１２との間のコール接続時間の間、プロファイラー１７は、必要に応じて圧縮器１５及び圧縮解除器１６のプロフィールを更新するために、パケットフィールドの挙動を継続して分析する。例えば、プロファイラー１７は所与のフィールドの挙動をよく理解している、即ちフィールドの挙動パターンが変化したことを突き止めることができる。例えば、プロファイラー１７が特定のフィールドが静的であるのを突き止めた場合

圧縮度を増加させる必要があれば、この更新情報が圧縮解除器１６に到達し、その確認情報を受取って初めて圧縮器１５がこの改善された圧縮方式を実行するようにするのが好ましい。

【００２８】

プロファイラーがプロフィールを形成した結果、圧縮器１５が正しい値よりも大きい圧縮度でパケットを圧縮している場合がある。例えば、プロファイラー１７が圧縮器１５に対して、あるフィールドはそのｎ個のパケットが変化しないため静的であると指示し、その後プロファイラー１７がそのフィールドの挙動が変化したことを突き止めた時にそのフィールドをそれに応じて圧縮するようにこの圧縮器１５に促す場合がある。この変化は圧縮器１５及び圧縮解除器１６へ直ちに伝えられるが、圧縮解除器１６へは帯域外通信または帯域内通信により通告するのが好ましい。例えば、プロフィールの更新情報は、移動局１２へ送られる圧縮状態のパケットに付着された多数のバイトとして符号化することができる。この同じ更新情報は、更新情報が圧縮器１５へ到達したことの確認指示を受けるまで種々の圧縮パケットに継続して付着してもよい。

【００２９】

さらに、プロファイラー１７が以前に遭遇した挙動パターンを必ずしもオーバーライドすることなく新しいタイプのフィールドの挙動を突き止めることができるように、単一のフィールドに多数のタイプの符号化を関連させてもよい。圧縮器１５及び圧縮解除器１６がこのデータを利用できるようにするため、プロファイラー１７はそれらに対して種々の符号化の確率を示す。従って、例えば、プロファイラー１７は、１つのフィールドが高い確率で静的であるが、変化の確率が小さい（０でない）ことを示すことができる。これにより、圧縮器１５及び圧縮解除器１６は、多量の帯域外通信を必要とすることなく予想される挙動からのわずかな変動に対処できる。

【００３０】

上述の例では、各パケットのフィールドの数、それらの順番及び各フィールドの長さが圧縮器１５及び圧縮解除器１６に知られているため、プロファイラー１７によるフィールド毎のパケット分析が可能であると仮定されている。例えば、通信が新しいプロトコルスタックに関連する新しいデータタイプを含む場合、通信開始時にかかる情報をこれらのエンティティが利用できる状態にならない場合がある。このような場合、プロファイラー１７は、受信パケットを分析することによりこれらのパケットの対応するサブセクションの挙動パターンを突き止めるように構成されている。

【００３１】

例えば、図５に示すように、各パケット全体は一列のオクテットとしてただ処理され、プロファイラー１７は、連続するパケットをチェックしてパケットの等価オクテット間の相関関係を突き止めるように構成されている。従って、フィールドの境界を突き止めようとせずに、プロファイラー１７は、経時的にパケットの挙動プロフィールをオクテット毎に形成する。例えば、プロファイラー１７は同じ値を維持するかまたはめったに変化しないかもしくは少数の値をとるオクテットを突き止める。フィールドの挙動に関連して上述したように、プロファイラー１７は、所与のオクテットの挙動パターンを突き止める度にこの情報を符号化して圧縮器１５及び圧縮解除器１６へ送り、これらがそれに応じて適当な圧縮／圧縮解除方式を実行する。

【００３２】

上述したフィールド長さが知られた例と同じように、プロファイラー１７は、基地局１１と移動局１２の間のコール接続時間の間継続してオクテットの挙動を分析することにより、圧縮器１５及び圧縮解除器１６においてプロフィールが必要に応じて更新されるようにする。

【００３３】

オクテット毎のパケットの挙動プロフィールの形成は一例であるが、プロファイラー１７は、任意の便利な大きさのパケットのサブセクション、例えば、１０ビット毎のパケットの挙動についてプロフィールを形成できることを理解されたい。

【００３４】
図６を参照して、本発明のさらに別の実施例を説明する。この実施例には、図２を参照して既に説明したコンポーネントには同一の参照番号が付されている。この実施例において、プロファイラー１７は、基地局１１でなくて移動局１２に配置されている。動作については、接続開始時に、基地局１１で受信されるパケットが最初に非圧縮状態で移動局１２へ送られる。移動局１２では、プロファイラー１７が受信パケットを分析して、パケットのプロフィールを突き止める。上述したように、パケットのフレームフォーマットが知られておれば、プロファイラー１７はパケットをフレーム毎に分析する。フレームフォーマットが知られていなければ、プロファイラー１７は、パケットをサブセクション毎に、例えば、オクテット毎に分析する。

【００３５】
何れの場合でも、プロファイラー１７が所与のフィールドまたは種々のサブセクションの挙動パターンを突き止める度に、この情報が圧縮解除器１６へ送られ、また移動局１２から基地局１１へ送られて、そこで、圧縮器１５へ供給される。上述した例におけると同様に、プロファイラー１７が圧縮器１５へ所与のフィールドまたはサブセクションの挙動を通告する度に、圧縮器は後続のパケットのそのフィールドまたはサブセクションについて適当な圧縮方式を使用し、圧縮解除器はそれらのパケットを受信すると相補的な適当な圧縮解除方式を使用することができる。この実施例において、受信パケットの分析は、圧縮解除器１６へ入力される前かまたは圧縮解除器１６から出力された後の何れかに行うように、プロファイラー１７を構成してもよい。

【００３６】
本発明のさらに別の実施例を図７に示す。この図では、図２及び６を参照して既に説明した特徴部分に同一参照番号が付されている。この実施例において、基地局１１と移動局１２には、それぞれ１７Ａ、１７Ｂで示すそれ自身のプロファイラーが設けられている。動作については、基地局１１がインターネット１４から受信するパケットは、上述したように、プロファイラー１７Ａが分析して、パケットのフィールドまたはサブセクションの挙動プロフィールを形成する。前と同じように、プロファイラー１７Ａが形成した各フィールドまたはサブセクションの挙動情報が圧縮器１５へ送られ、圧縮器は適当な圧縮方式を実行する。有利なことに、この実施例では、プロファイラー１７Ａが突き止めた情報を基地局１１から無線インターフェイス１３を介して移動局１２へ送信して圧縮解除器１６へ供給するのが不要である。その代わり、プロファイラー１７Ｂは基地局１１から受信するパケットにそれ自身で分析して、プロファイラー１７Ａが形成するものにマッチする、パケットまたはパケットサブセクションの何れかのフィールドの挙動プロフィールをそれ自身で形成する。プロファイラー１７Ｂが形成する各フィールドまたはサブセクションの挙動情報は圧縮解除器１６へ送られ、この圧縮解除器は圧縮器１５において適用される圧縮方式と相補的な適当な圧縮解除方式を実行する。

【００３７】
再び、圧縮器１５は最初に保守的な圧縮方式を実行するため、移動局１２へ送れられる最初のパケットは未圧縮状態である。前と同様に、圧縮器１５により実行される圧縮方式は、圧縮器１５がパケットのフィールド（またはサブセクション）の挙動を詳細に示すプロファイラー１７Ａからの情報を受けると改善される。有利なことに、パケットを圧縮解除するために圧縮解除器１６が必要とするフィールド（またはサブセクション）の挙動情報は第２のプロファイラー１７Ｂが局部的に発生するため、この情報を基地局１１から移動局１２へ送るのが不要であり、このため利用帯域幅が節約される。適当な技量を有する当業者は、２つのプロファイラー１７Ａ、１７Ｂを同期作動状態に維持する必要があることがわかるであろう。これは、例えば、規則的な同期信号を基地局１１から移動局１２へ専用制御チャンネルにより送信することにより達成できる。

【００３８】
本発明を、例示の目的だけのために、インターネット及びセルラー移動体通信ネットワークに関連して説明したことを理解されたい。本発明は、受信局での受信前にパケット流中

のデータパケットの圧縮が望ましい任意の通信システムまたはシステムの組合わせに利用可能である。例えば、本発明の無線ローカルエリアネットワークに特に有用であると思われる。

【００３９】

本発明を好ましい実施例に関して説明したが、問題の実施例は例示的なものにすぎず、変形例及び設計変更が頭書の特許請求の範囲に規定された本発明の範囲から逸脱することなく当業者にとって想到できるであろうことをよく理解されたい。

【図面の簡単な説明】

【図１】

図１は、パケットの概略図である。

【図２】

図２は、本発明のシステムのブロック図である。

【図３】

図３は、本発明の一実施例に用いるプロセスを説明する流れ図である。

【図４】

図４は、パケットのプロフィールを示す概念図である。

【図５】

図５は、パケットを概念的に一連のオクテットに分割した状態を示す概略図である。

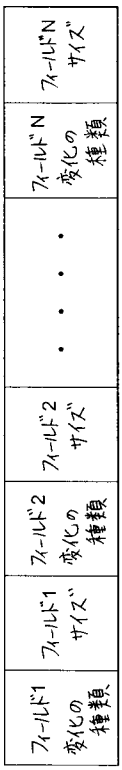
【図６】

図６は、本発明による別のシステムのブロック図である。

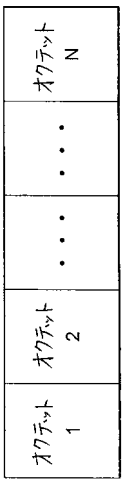
【図７】

図７は、別のシステムのブロック図である。

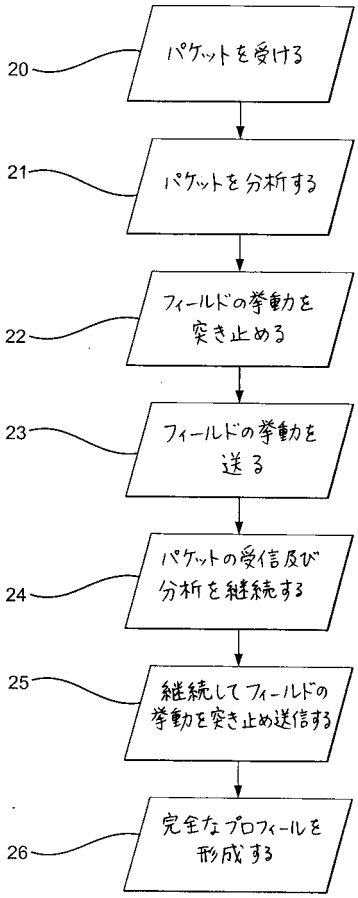
【図３】



【図４】



【図５】


20
パケットを受ける
21
パケットを分析する
22
フィールドの挙動を突き止める
23
フィールドの挙動を送る
24
パケットの受信及び分析を継続する
25
継続してフィールドの挙動を突き止め送信する
26
完全なプロフィールを形成する

【国際公開パンフレット】

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
4 April 2002 (04.04.2002)

PCT

(10) International Publication Number
WO 02/26860 A1

(51) International Patent Classification[7]: C08G 61/12, A61K 31/00

(21) International Application Number: PCT/GB01/04308

(22) International Filing Date:
26 September 2001 (26.09.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0023766.9 28 September 2000 (28.09.2000) GB
0102158.3 29 January 2001 (29.01.2001) GB

(71) Applicant *(for all designated States except US)*: **ROKE MANOR RESEARCH LIMITED** [GB/GB]; Old Salisbury Lane, Romsey, Southampton, Hampshire SO51 0ZN (GB).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **McCANN, Stephen** [GB/GB]; 1 Jeffries Close, Rownhams, Southampton, Hampshire SO16 8DS (GB). **WEST, Mark** [GB/GB]; 5 Langham Close, North Baddesley, Southampton, Hampshire SO52 9NT (GB). **HANCOCK, Robert** [GB/GB]; 22 River View Road, Bitterne Park, Southampton, Hampshire SO18 1NW (GB).

(74) Agents: **ALLEN, Derek** et al.; Intellectual Property Department, Siemens Shared Services Limited, Siemens House, Oldbury, Bracknell, Berkshire RG12 8FZ (GB).

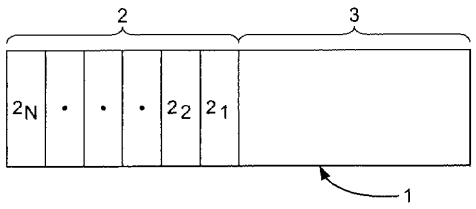
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** A METHOD OF PROCESSING DATA PACKETS



(57) **Abstract:** There is described a method of processing data packets in a data stream in a communication system. In the method, a plurality of data packets from the data stream are analysed in order to generate profile data which indicates how one or more parts of each of the plurality of data packets varies from data packet to data packet. The profile data is then made available so that a data packet compression scheme that accords with the profile data can be implemented on data packets in the communication system.

WO 02/26860 A1

A Method of Processing Data Packets

This invention relates to a method of processing data packets.

In many digital communication networks, data is transmitted from a sending station to a receiving station in the form of discrete variable sized portions, commonly referred to as packets. Various communications protocols have been developed which define the procedures for sending packets of data from one station in a network to another station and which also define the procedures that determine how the packets will be processed at the sending and receiving stations. For any communication, there are many functions that may need to be performed by a protocol and in practice there are so many that a set or suite of protocols is used, each protocol in the suite handling one or more specific aspects of the communication. Perhaps the best known protocol suite is the Transmission Control Protocol/Internet Protocol (TCP/IP) which is widely used on the Internet.

A schematic representation of a simple packet 1 is shown in Figure 1. In common with all packets, the packet 1 can be thought of comprising two parts, a header 2 (also known as the Protocol Control Information (PCI)) and a payload 3 (the actual data to be sent to the receiving node). The header 2 comprises a number of fields, indicated as 2_1 to 2_N, each field containing information important to the communication. Examples of fields that a header may comprise are, a 'source field' indicating the address of the sending station, a 'destination field' indicating the address of the receiving station, an 'amount of data field' indicating the size of the payload and an 'identification field' identifying the sequence number of the packet. Many other field types will be known to those skilled in the art.

The protocol suite associated with a particular packet does not define the data carried in the payload part of the packet but it does specify the format of the header, for example, the different types of fields present in the header, the length and ordering of the fields and the way in which the pattern of bits which make up the fields are to be interpreted.

Mobile telecommunications networks and the Internet are converging in terms of their functionality. It is desirable for so called third generation (3G) mobile handsets to be able to deal with Internet data packets directly, to allow mobile users access to seamless e-mail, web browsing, multimedia and other services. Protocols such as TCP/IP have been designed primarily for fixed networks where available bandwidth is relatively more plentiful then that available in wireless networks. When used to carry speech, the message overhead resulting from packet headers can take up to 75% of the total network capacity, which is unacceptable for mobile networks.

To alleviate this problem, various compression schemes have been developed for compressing packet headers prior to the packets being transmitted over the wireless interface. An example of such a scheme is the well known Van Jacobson scheme described in 'RFC 1144'.

In previous header compression systems both the entity that performs the header compression and the entity that performs the subsequent decompression are pre-configured to have access to a stored record of the header profiles of packets associated with any of the known protocol stacks that it is anticipated that the entities may have to deal with.

A header profile is in effect, a definition of how the value of each particular field in the header varies or behaves from packet to packet. For example, a simple header,

associated with a notional protocol stack Z may comprise three fields A, B and C and the profile may be 'Field A = static, Field B = irregular and Field C = linear' meaning that the value of field A does not vary from packet to packet, the value of field B varies randomly from packet to packet and the value of field C varies linearly from packet to packet.

Having access to header profiles allows compressors and associated de-compressors to implement compression and subsequent de-compression techniques optimised for the particular protocol suite being used. For example, on receiving packets having headers defined by notional protocol stack Z, knowing the header profile associated with protocol stack Z allows the compressor to implement a compression scheme in which for each packet, Field A is compressed using 'Static Field Encoding', Field B is compressed using ' irregular Field Encoding' and Field C is compressed using 'Linear Field Encoding'. Likewise, knowing the header profile allows a de-compressor to implement an optimised de-compression method.

It is not uncommon for known header compressor/de-compressor systems to be expected to deal with new types of packet data in which the headers are defined by a new protocol stack (or perhaps a variation on an old protocol stack), with which the system has not dealt with before. To do this, the store of header profiles to which the system has access must first be updated with the header profile associated with the new protocol stack.

This is possible, although inconvenient, in network base to base communication, where the profile update can be performed by a network administrator but is more difficult where the communication involves a mobile station, for example, a mobile phone.

The present invention aims to overcome or at least alleviate the above mentioned problems.

According to the invention there is provided a method of processing data packets in a data stream in a communication system, the method comprising: receiving a plurality of data packets; analysing the plurality of data packets; generating in response to the analysis, profile data which indicates how one or more parts of each of the plurality of data packets varies from data packet to data packet; and making the profile data available so that a data packet compression scheme that accords with the profile data can be implemented on data packets in the data stream.

According to the invention there is also provided an apparatus for processing data packets in a communication system, the apparatus comprising: means for receiving a plurality of data packets; means for analysing the plurality of data packets; means for generating in response to the analysis, profile data which indicates how one or more parts of each of the plurality of packets varies from data packet to data packet; and means for making the profile data available for use in selecting a data packet compression scheme that accords with the profile data.

According to the invention there is also provided a system of processing data packets in a data stream in a communication network, the system comprising: receiving a plurality of data packets in the data stream; analysing the plurality of data packets to generate behaviour data that indicates how at least a part of each of the plurality of packets behaves from data packet to data packet; implementing a data packet compression scheme in accordance with the behaviour data on data packets in the data stream.

Embodiments of the present invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a schematic representation of a packet;

Figure 2 is a block diagram of a system embodying the invention;

Figure 3 is a flow diagram illustrating a process used in an embodiment of the invention;

Figure 4 is a conceptual illustration of a packet profile;

Figure 5 is a schematic representation of a packet notionally divided into a string of octets;

Figure 6 is a block diagram of another system embodying the invention;

Figure 7 is a block diagram of another system embodying the invention;

Referring now to Figure 2 there is illustrated a system embodying the present invention. The system comprises a cellular mobile communication network 10, comprising at least one base station 11 for communicating with at least one mobile station or phone 12 operating in the base station's 11 area of coverage. The mobile network 10 may for example be a GSM network or a UMTS network. The structure and function of the components that make up such networks, for example, mobile stations, base stations, base station controllers, gateways and the like that provide for base station to mobile station communication and which connect the mobile network to other communication networks such as the PSTN or the Internet are well known to those skilled in the art and need not be discussed in any detail here.

Furthermore, as is well known to those skilled in the art, mobile stations may now incorporate hardware/software that enable the station to handle data transmitted to the mobile network in which the mobile station is operating from or via public data

networks such as the Internet. The data may take many forms, including for example, voice, video and text data and web pages.

In the embodiment illustrated in Figure 2, the mobile station 12 receives from the base station 11, via the wireless interface 13, packet data transmitted to the mobile network 10 from the internet 14. The base station 11 is provided with a compressor 15 for compressing received packets prior to the packets being transmitted over the wireless interface 13. The compressor 15 is primarily for compressing packet headers, although it may also compress the packet payloads.

The compressor 15 comprises a programme stored at the base station 11 and which is executed on a processor (not shown) present in the base station to compress received packets, prior to them being transmitted to the mobile station 12. As mentioned in the introduction, suitable compression algorithms for compressing packets are well known to those skilled in the art.

Correspondingly, the mobile station 12 is provided with a de-compressor 16, for de-compressing compressed packet received from the base station 11. The de-compressor 16 comprises a programme stored at the mobile station 12 and which is executed on a processor (not shown) present in the mobile station 12 to de-compress the packets. De-compression algorithms for de-compressing packets are well known to those skilled in the art.

The base station 11 is further provided with an entity 17 which for convenience will be referred to hereinbelow as a 'profiler'. The profiler 17 comprises software stored at the base station 11 and executed on a processor (not shown) located in the base station 11. The function of the profiler 17 is to analyse packets in a packet stream intended for the mobile station 12 to identify a profile or pattern of how the value of

corresponding bit sequences in different packets behaves from packet to packet. Having identified such behaviour patterns, the profiler 17 sends this information to both the compressor 15 and also the de-compressor 16 to allow these entities to implement an optimal compression/de-compression scheme for the data packets. Thus, unlike in previous systems, the compressor 15 and de-compressor 16 need not have any a priori information about the profile of packets in a given packet stream to enable packet compression and subsequent de-compression to be achieved and are therefore able to deal with arbitrary packet streams.

Referring now to Figure 3 as well as Figure 2, an example of a process used in an embodiment of the invention will be given. In this example, the number of fields in each packet, their ordering, and the length of each field is known to the compressor 15 at connection set up. However, the behaviour of corresponding fields from packet to packet is unknown and is to be determined by the profiler 17.

As data packets begin arriving at the base station 11, step 20, the profiler 17 commences analysing the packets to determine how the value of equivalent fields differs from packet to packet, step 21. In step 22, enough packets have been analysed for the profiler to have determined the behaviour of at least one of the fields in the packets, and this information is sent to the compressor 15 and also to the de-compressor 16, step 23. The profiler 17 continues analysing packets as they arrive, step 24, to determine the behaviour of more of the fields, and each time the behaviour of a field is identified, this information is transmitted to the compressor 15 and the de-compressor 16, step 25. This process continues, step 26, until eventually the profiler 17 has developed a full profile of the received packets, in other words, information on the behavioural pattern of each field in the packets.

A conceptual illustration of a packet profile is shown in Figure 4. For each field in the packet, the profile indicates the size of the field and how the field varies from packet to packet. In the above example, the compressor has prior knowledge of the size of each field and so the profiler 17 need only determine the behaviour of each field.

The packets received at the base station 11 may have a number of fields that will either, remain static for the duration of the call connection, change in a predictable fashion, for example a linear fashion, for the duration of the connection or change irregularly for the duration of the connection. Each time the profiler 17 notifies the compressor 15 of the behaviour of a given field, the compressor 15 is then able to implement an appropriate compression technique for that field in subsequent packets. For example, a field that is observed not to change from packet to packet can be elided from further compressed packets transmitted to the mobile station 12 and a field that is observed to change in say a linear fashion can be compressed using a technique appropriate for linearly varying fields. Appropriate compression techniques for each type of field behaviour will be known to those skilled in the art. Notifying the de-compressor 16 of the behaviour of a given field allows the de-compressor 16 to implement a complementary de-compression technique on that field in the compressed packets.

At connection set up, the compressor 15 will have no information on the behaviour of any of the fields in the packets. Thus, initially uncompressed packets will have be sent to the mobile station 12. As information on field behaviour is developed by the profiler 17 the compressor 15 then begins to implement a compression scheme on the packets, which initially will be quite a conservative scheme. This scheme will be enhanced and refined as and when the compressor 15 receives more information from

the profiler 17, allowing the compressor 15 to implement appropriate compression techniques on more and more of the various fields.

Throughout the duration of the call connection between the base station 11 and the mobile station 12, the profiler 17 continues to analyse the behaviour of the packet fields in order to, if necessary, update the profile at the compressor 15 and also at the de-compressor 16. For instance, the profiler 17 may determine a better understanding of the behaviour of a given field, or determine that the behaviour pattern of a field has changed. In such instances, where the degree of compression is to be increased, for example if the profiler 17 has determined that a particular field is static, it is preferred to wait for this update to reach the de-compressor 16 and be acknowledged before the compressor 15 implements a refined compression scheme.

In other instances, the compressor 15 as a result of the profile generated by the profiler may be compressing packets to a greater degree then is correct. For example, the profiler 17 may have indicated to the compressor 15 that a field that had not changed for n packets is static, prompting the compressor 15 to compress that field accordingly, when subsequently the profiler 17 determines that the behaviour of that field has changed. Preferably, this change is signalled to the compressor 15 and de-compressor 16 immediately, to the de-compressor 16 using out-of band signalling or alternatively in-band signalling. For example, a profile update may be encoded as a number of additional bytes that are attached to a compressed packet sent to the mobile station 12. The same update may be persistently attached to different compressed packets until acknowledgement that the update has reached the compressor 15 is received.

Additionally, multiple types of encoding may be associated with a single field, to allow the profiler 17 to identify new types of field behaviour without necessarily

overriding previously seen behaviour patterns. In order to allow the compressor 15 and de-compressor 16 to make use of this data, the profiler 17 may indicate to them the probabilities of the different encodings. Thus, for example, the profiler 17 may indicate that a field is static with high probability but has a small (non-zero) probability of changing. This should allow the compressor 15 and de-compressor 16 to manage slight deviations from expected behaviour without requiring large amounts of out-of band signalling.

In the above described example, it is assumed that the number of fields in each packet, their ordering, and the length of each field is known to the compressor 15 and the de-compressor 16, allowing the profiler 17 to analyse the packets on a field by field basis. In some instances, for example, if the communication involves a new data-type, associated with a new protocol stack, such information will not be available to these entities at connection set-up. In such instances, the profiler 17 is arranged to analyse received packets so as to identify behaviour patterns in equivalent sub-sections of the packets.

For example, as illustrated in Figure 5 each whole packet may be treated simply as a string of octets and the profiler 17 arranged to examine successive packets looking for correlation between equivalent octets in the packets. Thus, without trying to identify field boundaries, the profiler 17 profiles the packet behaviour over time on an octet by octet basis. For example, the profiler 17 identifies octets that retain the same value, or that rarely change, or that take on a small number of values. As described above with respect to field behaviour, each time the profiler 17 identifies a pattern in the behaviour of a given octet this information is encoded and passed to the compressor 15 and de-

compressor 16 which implement an appropriate compression/de-compression scheme accordingly.

As with the known field length example discussed above, throughout the duration of the call connection between the base station 11 and the mobile station 12, the profiler 17 continues to analyse the behaviour of the octets in order to update the profile at the compressor 15 and also at the de-compressor 16 as and when necessary.

It will be understood that profiling packet behaviour on an octet by octet basis is given by way of example only, and the profiler 17 could be configured to profile packet behaviour on the basis of packet sub-sections of any convenient size, for example 10 bits.

A further embodiment of the invention will now be described with reference to Figure 6, in which components already described with respect to Figure 2 are given similar reference numerals. In this embodiment, the profiler 17 rather than being located in the base station 11 is located in the mobile station 12. In operation, at connection set up, packets received at the base station 11 are initially transmitted to the mobile station 12 un-compressed. At the mobile station 12, the profiler 17 analyses received packets to determine the profile of the packets. As described above, if the frame format of the packets is known then the profiler 17 analyses the packets on a frame by frame basis. If the frame format is not known, then the profiler 17 analyses the packets on a sub-section by sub-section basis, for example octet by octet.

In either case, each time the profiler 17 determines the behaviour pattern of a given field or a given sub-section, this information is passed to the de-compressor 16 and is also transmitted from the mobile station 12 to the base station 11 where it is passed to the compressor 15. As in the examples described above, each time the profiler

17 notifies the compressor 15 of the behaviour of a given field or sub-section, the compressor is then able to use an appropriate compression technique for that field or sub-section in subsequent packets and the de-compressor is able to use an appropriate complementary de-compression technique on those packets when they are received. In this embodiment, the profiler 17 may be arranged to analyse received packets either before they are input to the de-compressor 16 or after they are output from the de-compressor 16.

A further embodiment of the invention is illustrated in Figure 7 in which features already described with respect to Figures 2 and 6 are again given similar reference numerals. In this embodiment, both the base station 11 and the mobile station 12 are provided with their own profiler, indicated as 17a and 17b respectively. In operation, packets received at the base station 11 from the internet 14 are, as described hereinbefore, analysed by the profiler 17a to develop a profile of the behaviour of either fields in the packet or sub-sections of the packets. As before, the information on the behaviour of each field or sub section developed by the profiler 17a is sent to the compressor 15 which then implements appropriate compression techniques. Advantageously, in this embodiment, there is no need for the information determined by the profiler 17a to be sent from the base station 11 over the wireless interface 13 to the mobile station 12 for passing to the de-compressor 16. Instead, the profiler 17b performs its own analysis on packets received from the base station 11, to develop its own profile of the behaviour of either fields in the packet or sub-sections of the packets, which matches that developed by the profiler 17a. The information on the behaviour of each field or sub-section developed by the profiler 17b is sent to the de-compressor 16

which then implements appropriate de-compression techniques that are complementary to the compression techniques applied at the compressor 15.

Again, the compressor 15 will initially implement a conservative compression scheme with the initial packets transmitted to the mobile station 12 not being compressed. As before, the compression scheme implemented by the compressor 15 will be enhanced and refined as and when the compressor 15 receives information from the profiler 17a detailing the behaviour of the fields (or the sub-sections) of the packets. Advantageously, since the information on the field (or sub-section) behaviour required by the de-compressor 16 in order to de-compress packets, is generated locally by the second profiler 17b there is no requirement for this information to be signalled from the base-station 11 to the mobile station 12, thereby saving on bandwidth usage. It will be appreciated by those possessed of the appropriate skills that the two profilers 17a and 17b must be kept operating in synchronisation. This may be achieved, for example, by transmitting a regular synchronisation signal from the base station 11 to the mobile station 12 on a dedicated control channel

It is to be understood that the invention has been described with reference to the Internet and a cellular mobile communications network for illustration only. The invention may find application in any communication system or combination of systems where it is desirable to compress data packets in a packet flow prior to the packets being received at a receiving station. For example, it is envisaged that the invention may find particular application in wireless local area networks.

Having thus described the present invention by reference to preferred embodiments it is to be well understood that the embodiments in question are exemplary only, and that modifications and variations such as will occur to those possessed of

appropriate knowledge and skills may be made without departure from the scope of the invention as defined in the appended claims.

Claims

1. A method of processing data packets in a data stream in a communication system, the method comprising:
receiving a plurality of data packets from the data stream;
analysing the plurality of data packets;
generating in response to the analysis, profile data which indicates how one or more parts of each of the plurality of data packets varies from data packet to data packet; and
making the profile data available so that a data packet compression scheme that accords with the profile data can be implemented on data packets in the data stream.

2. A method according to claim 1, the method further comprising:
sending the profile data to a compressor which implements the compression scheme on data packets in the data stream in the communications system.

3. A method according to claim 2, wherein the profile data is transmitted over a network link to the compressor.

4. A method according to any of claims 2 or 3, the method further comprising:
making the profile data available so that a data packet de-compression scheme that it is complementary to the data packet compression scheme can be implemented on packets in the data stream.

5. A method according to claim 4, the method further comprising:

sending the profile data to a de-compressor which implements the de-compression scheme in order de-compress packets in the data stream that have been compressed by the compressor.

6. A method according to claim 5, wherein the profile data is transmitted over a network link to the de-compressor

7. A method according to claim 6, wherein the profile data is transmitted over a wireless interface to the de-compressor.

8. A method according to claim 6 or 7, wherein the profile data is encoded as a bit string and attached to a data packet for transmission to the de-compressor.

9. A method according to any preceding claim wherein the plurality of packets are analysed such that the profile data indicates how one or more frames of the packets varies from packet to packet.

10. A method according to claim 9 wherein the one or more frames are header frames.

11. A method according to any of claims 1 to 8 wherein the plurality of packets are analysed such that the profile data indicates how one or more sub-sections a predefined number of bits long of each packet varies from packet to packet.

12. A computer programme for implementing the method of claim 1 when executed on a processor.

13. An apparatus for processing data packets in a communication system, the apparatus comprising:
means for receiving a plurality of data packets;
means for analysing the plurality of data packets;
means for generating in response to the analysis, profile data which indicates how one or more parts of each of the plurality of packets varies from data packet to data packet; and
means for making the profile data available for use in selecting a data packet compression scheme that accords with the profile data.

14. A system of processing data packets in a data stream in a communication network, the system comprising:
receiving a plurality of data packets in the data stream;
analysing the plurality of data packets to generate behaviour data that indicates how at least a part of each of the plurality of packets behaves from data packet to data packet;

implementing a data packet compression scheme in accordance with the behaviour data on data packets in the data stream.

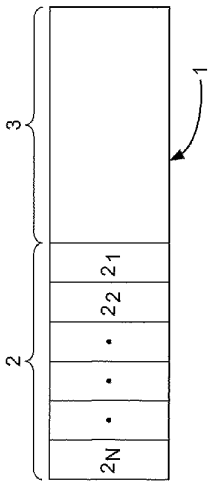


Fig. 1

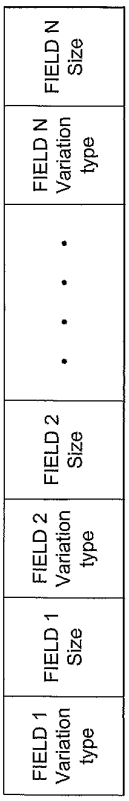


Fig. 4

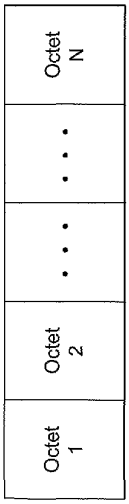


Fig. 5

Fig.2

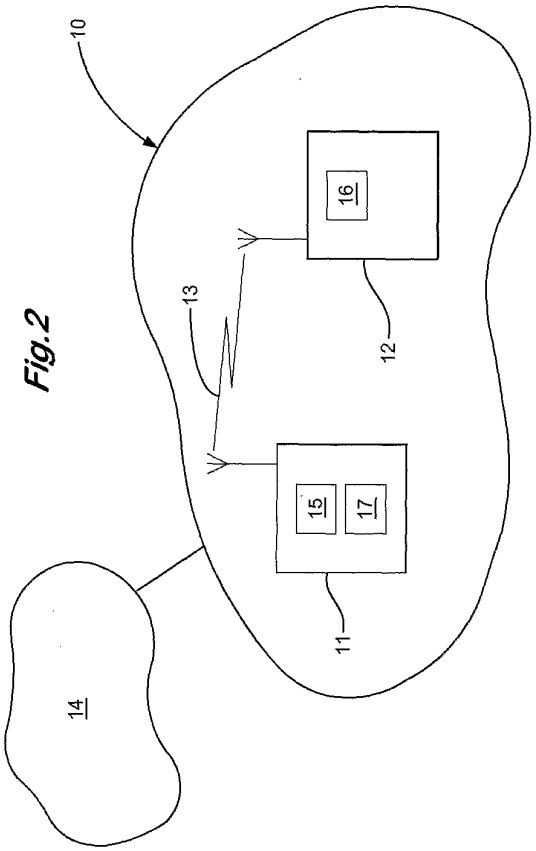


Fig.3

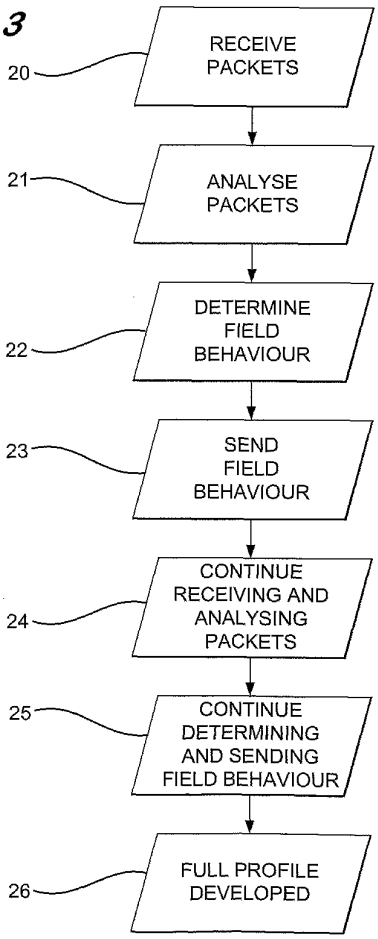

RECEIVE PACKETS
20
ANALYSE PACKETS
21
DETERMINE FIELD BEHAVIOUR
22
SEND FIELD BEHAVIOUR
23
CONTINUE RECEIVING AND ANALYSING PACKETS
24
CONTINUE DETERMINING AND SENDING FIELD BEHAVIOUR
25
FULL PROFILE DEVELOPED
26

Fig.6

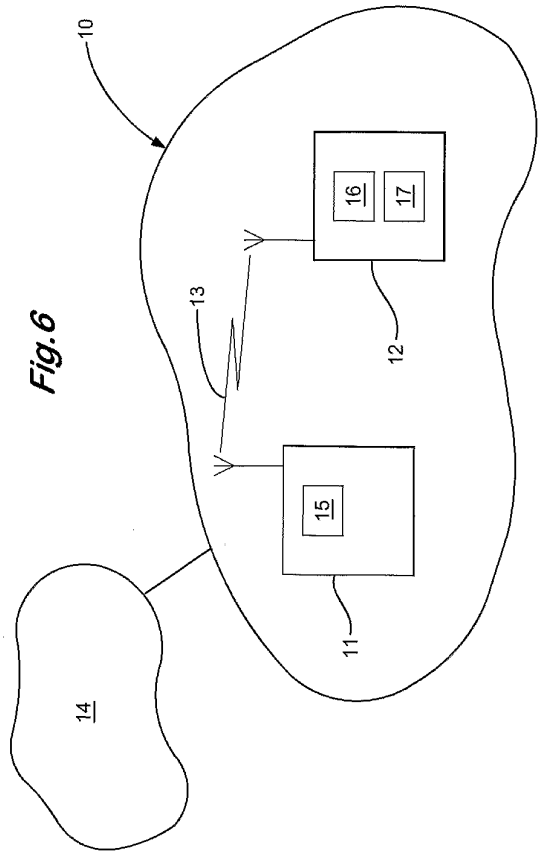
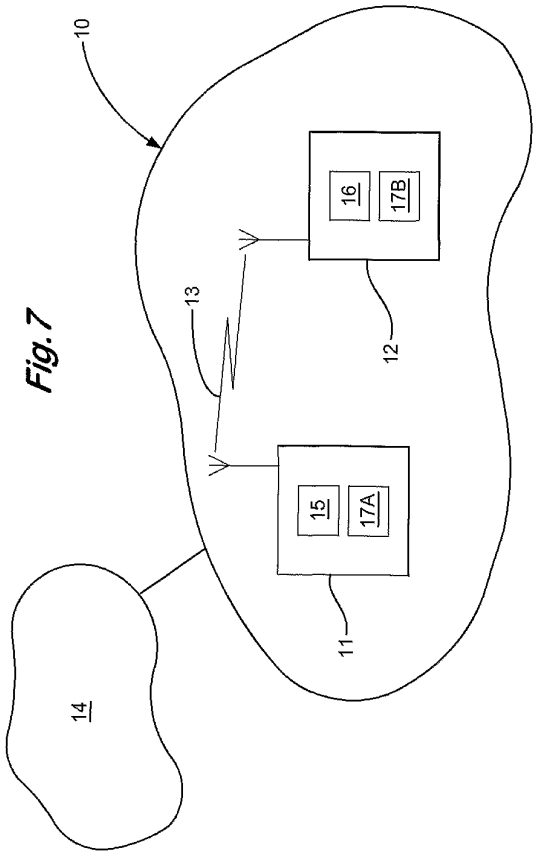


Fig.7



【国際公開パンフレット（コレクトバージョン）】

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

CORRECTED VERSION

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
4 April 2002 (04.04.2002)

PCT

(10) International Publication Number
WO 02/026860 A1

(51) International Patent Classification[7]: G06T 9/00

(21) International Application Number: PCT/GB01/04308

(22) International Filing Date:
26 September 2001 (26.09.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0023766.9 28 September 2000 (28.09.2000) GB
0102158.3 29 January 2001 (29.01.2001) GB

(71) Applicant *(for all designated States except US)*: **ROKE MANOR RESEARCH LIMITED** [GB/GB]; Old Salisbury Lane, Romsey, Southampton, Hampshire SO51 0ZN (GB).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **McCANN, Stephen** [GB/GB]; 1 Jeffries Close, Rownhams, Southampton, Hampshire SO16 8DS (GB). **WEST, Mark** [GB/GB]; 5 Langham Close, North Baddesley, Southampton, Hampshire SO52 9NT (GB). **HANCOCK, Robert** [GB/GB]; 22 River View Road, Bitterne Park, Southampton, Hampshire SO18 1NW (GB).

(74) Agents: **ALLEN, Derek** et al.; Intellectual Property Department, Siemens Shared Services Limited, Siemens House, Oldbury, Bracknell, Berkshire RG12 8FZ (GB).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

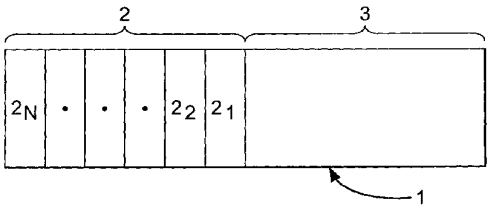
Published:
— *with international search report*

(48) Date of publication of this corrected version:
27 December 2002

(15) Information about Correction:
see PCT Gazette No. 52/2002 of 27 December 2002, Section II

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: A METHOD OF PROCESSING DATA PACKETS



(57) Abstract: There is described a method of processing data packets in a data stream in a communication system. In the method, a plurality of data packets from the data stream are analysed in order to generate profile data which indicates how one or more parts of each of the plurality of data packets varies from data packet to data packet. The profile data is then made available so that a data packet compression scheme that accords with the profile data can be implemented on data packets in the communication system.

WO 02/026860 A1

A Method of Processing Data Packets

This invention relates to a method of processing data packets.

In many digital communication networks, data is transmitted from a sending station to a receiving station in the form of discrete variable sized portions, commonly referred to as packets. Various communications protocols have been developed which define the procedures for sending packets of data from one station in a network to another station and which also define the procedures that determine how the packets will be processed at the sending and receiving stations. For any communication, there are many functions that may need to be performed by a protocol and in practice there are so many that a set or suite of protocols is used, each protocol in the suite handling one or more specific aspects of the communication. Perhaps the best known protocol suite is the Transmission Control Protocol/Internet Protocol (TCP/IP) which is widely used on the Internet.

A schematic representation of a simple packet 1 is shown in Figure 1. In common with all packets, the packet 1 can be thought of comprising two parts, a header 2 (also known as the Protocol Control Information (PCI)) and a payload 3 (the actual data to be sent to the receiving node). The header 2 comprises a number of fields, indicated as 2_1 to 2_N, each field containing information important to the communication. Examples of fields that a header may comprise are, a 'source field' indicating the address of the sending station, a 'destination field' indicating the address of the receiving station, an 'amount of data field' indicating the size of the payload and an 'identification field' identifying the sequence number of the packet. Many other field types will be known to those skilled in the art.

The protocol suite associated with a particular packet does not define the data carried in the payload part of the packet but it does specify the format of the header, for example, the different types of fields present in the header, the length and ordering of the fields and the way in which the pattern of bits which make up the fields are to be interpreted.

Mobile telecommunications networks and the Internet are converging in terms of their functionality. It is desirable for so called third generation (3G) mobile handsets to be able to deal with Internet data packets directly, to allow mobile users access to seamless e-mail, web browsing, multimedia and other services. Protocols such as TCP/IP have been designed primarily for fixed networks where available bandwidth is relatively more plentiful then that available in wireless networks. When used to carry speech, the message overhead resulting from packet headers can take up to 75% of the total network capacity, which is unacceptable for mobile networks.

To alleviate this problem, various compression schemes have been developed for compressing packet headers prior to the packets being transmitted over the wireless interface. An example of such a scheme is the well known Van Jacobson scheme described in 'RFC 1144'.

In previous header compression systems both the entity that performs the header compression and the entity that performs the subsequent decompression are pre-configured to have access to a stored record of the header profiles of packets associated with any of the known protocol stacks that it is anticipated that the entities may have to deal with.

A header profile is in effect, a definition of how the value of each particular field in the header varies or behaves from packet to packet. For example, a simple header,

associated with a notional protocol stack Z may comprise three fields A, B and C and the profile may be 'Field A = static, Field B = irregular and Field C = linear' meaning that the value of field A does not vary from packet to packet, the value of field B varies randomly from packet to packet and the value of field C varies linearly from packet to packet.

Having access to header profiles allows compressors and associated de-compressors to implement compression and subsequent de-compression techniques optimised for the particular protocol suite being used. For example, on receiving packets having headers defined by notional protocol stack Z, knowing the header profile associated with protocol stack Z allows the compressor to implement a compression scheme in which for each packet, Field A is compressed using 'Static Field Encoding', Field B is compressed using ' irregular Field Encoding' and Field C is compressed using 'Linear Field Encoding'. Likewise, knowing the header profile allows a de-compressor to implement an optimised de-compression method.

It is not uncommon for known header compressor/de-compressor systems to be expected to deal with new types of packet data in which the headers are defined by a new protocol stack (or perhaps a variation on an old protocol stack), with which the system has not dealt with before. To do this, the store of header profiles to which the system has access must first be updated with the header profile associated with the new protocol stack.

This is possible, although inconvenient, in network base to base communication, where the profile update can be performed by a network administrator but is more difficult where the communication involves a mobile station, for example, a mobile phone.

The present invention aims to overcome or at least alleviate the above mentioned problems.

According to the invention there is provided a method of processing data packets in a data stream in a communication system, the method comprising: receiving a plurality of data packets; analysing the plurality of data packets; generating in response to the analysis, profile data which indicates how one or more parts of each of the plurality of data packets varies from data packet to data packet; and making the profile data available so that a data packet compression scheme that accords with the profile data can be implemented on data packets in the data stream.

According to the invention there is also provided an apparatus for processing data packets in a communication system, the apparatus comprising: means for receiving a plurality of data packets; means for analysing the plurality of data packets; means for generating in response to the analysis, profile data which indicates how one or more parts of each of the plurality of packets varies from data packet to data packet; and means for making the profile data available for use in selecting a data packet compression scheme that accords with the profile data.

According to the invention there is also provided a system of processing data packets in a data stream in a communication network, the system comprising: receiving a plurality of data packets in the data stream; analysing the plurality of data packets to generate behaviour data that indicates how at least a part of each of the plurality of packets behaves from data packet to data packet; implementing a data packet compression scheme in accordance with the behaviour data on data packets in the data stream.

Embodiments of the present invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a schematic representation of a packet;

Figure 2 is a block diagram of a system embodying the invention;

Figure 3 is a flow diagram illustrating a process used in an embodiment of the invention;

Figure 4 is a conceptual illustration of a packet profile;

Figure 5 is a schematic representation of a packet notionally divided into a string of octets;

Figure 6 is a block diagram of another system embodying the invention;

Figure 7 is a block diagram of another system embodying the invention;

Referring now to Figure 2 there is illustrated a system embodying the present invention. The system comprises a cellular mobile communication network 10, comprising at least one base station 11 for communicating with at least one mobile station or phone 12 operating in the base station's 11 area of coverage. The mobile network 10 may for example be a GSM network or a UMTS network. The structure and function of the components that make up such networks, for example, mobile stations, base stations, base station controllers, gateways and the like that provide for base station to mobile station communication and which connect the mobile network to other communication networks such as the PSTN or the Internet are well known to those skilled in the art and need not be discussed in any detail here.

Furthermore, as is well known to those skilled in the art, mobile stations may now incorporate hardware/software that enable the station to handle data transmitted to the mobile network in which the mobile station is operating from or via public data

networks such as the Internet. The data may take many forms, including for example, voice, video and text data and web pages.

In the embodiment illustrated in Figure 2, the mobile station 12 receives from the base station 11, via the wireless interface 13, packet data transmitted to the mobile network 10 from the internet 14. The base station 11 is provided with a compressor 15 for compressing received packets prior to the packets being transmitted over the wireless interface 13. The compressor 15 is primarily for compressing packet headers, although it may also compress the packet payloads.

The compressor 15 comprises a programme stored at the base station 11 and which is executed on a processor (not shown) present in the base station to compress received packets, prior to them being transmitted to the mobile station 12. As mentioned in the introduction, suitable compression algorithms for compressing packets are well known to those skilled in the art.

Correspondingly, the mobile station 12 is provided with a de-compressor 16, for de-compressing compressed packet received from the base station 11. The de-compressor 16 comprises a programme stored at the mobile station 12 and which is executed on a processor (not shown) present in the mobile station 12 to de-compress the packets. De-compression algorithms for de-compressing packets are well known to those skilled in the art.

The base station 11 is further provided with an entity 17 which for convenience will be referred to hereinbelow as a 'profiler'. The profiler 17 comprises software stored at the base station 11 and executed on a processor (not shown) located in the base station 11. The function of the profiler 17 is to analyse packets in a packet stream intended for the mobile station 12 to identify a profile or pattern of how the value of

corresponding bit sequences in different packets behaves from packet to packet. Having identified such behaviour patterns, the profiler 17 sends this information to both the compressor 15 and also the de-compressor 16 to allow these entities to implement an optimal compression/de-compression scheme for the data packets. Thus, unlike in previous systems, the compressor 15 and de-compressor 16 need not have any a priori information about the profile of packets in a given packet stream to enable packet compression and subsequent de-compression to be achieved and are therefore able to deal with arbitrary packet streams.

Referring now to Figure 3 as well as Figure 2, an example of a process used in an embodiment of the invention will be given. In this example, the number of fields in each packet, their ordering, and the length of each field is known to the compressor 15 at connection set up. However, the behaviour of corresponding fields from packet to packet is unknown and is to be determined by the profiler 17.

As data packets begin arriving at the base station 11, step 20, the profiler 17 commences analysing the packets to determine how the value of equivalent fields differs from packet to packet, step 21. In step 22, enough packets have been analysed for the profiler to have determined the behaviour of at least one of the fields in the packets, and this information is sent to the compressor 15 and also to the de-compressor 16, step 23. The profiler 17 continues analysing packets as they arrive, step 24, to determine the behaviour of more of the fields, and each time the behaviour of a field is identified, this information is transmitted to the compressor 15 and the de-compressor 16, step 25. This process continues, step 26, until eventually the profiler 17 has developed a full profile of the received packets, in other words, information on the behavioural pattern of each field in the packets.

A conceptual illustration of a packet profile is shown in Figure 4. For each field in the packet, the profile indicates the size of the field and how the field varies from packet to packet. In the above example, the compressor has prior knowledge of the size of each field and so the profiler 17 need only determine the behaviour of each field.

The packets received at the base station 11 may have a number of fields that will either, remain static for the duration of the call connection, change in a predictable fashion, for example a linear fashion, for the duration of the connection or change irregularly for the duration of the connection. Each time the profiler 17 notifies the compressor 15 of the behaviour of a given field, the compressor 15 is then able to implement an appropriate compression technique for that field in subsequent packets. For example, a field that is observed not to change from packet to packet can be elided from further compressed packets transmitted to the mobile station 12 and a field that is observed to change in say a linear fashion can be compressed using a technique appropriate for linearly varying fields. Appropriate compression techniques for each type of field behaviour will be known to those skilled in the art. Notifying the de-compressor 16 of the behaviour of a given field allows the de-compressor 16 to implement a complementary de-compression technique on that field in the compressed packets.

At connection set up, the compressor 15 will have no information on the behaviour of any of the fields in the packets. Thus, initially uncompressed packets will have be sent to the mobile station 12. As information on field behaviour is developed by the profiler 17 the compressor 15 then begins to implement a compression scheme on the packets, which initially will be quite a conservative scheme. This scheme will be enhanced and refined as and when the compressor 15 receives more information from

the profiler 17, allowing the compressor 15 to implement appropriate compression techniques on more and more of the various fields.

Throughout the duration of the call connection between the base station 11 and the mobile station 12, the profiler 17 continues to analyse the behaviour of the packet fields in order to, if necessary, update the profile at the compressor 15 and also at the de-compressor 16. For instance, the profiler 17 may determine a better understanding of the behaviour of a given field, or determine that the behaviour pattern of a field has changed. In such instances, where the degree of compression is to be increased, for example if the profiler 17 has determined that a particular field is static, it is preferred to wait for this update to reach the de-compressor 16 and be acknowledged before the compressor 15 implements a refined compression scheme.

In other instances, the compressor 15 as a result of the profile generated by the profiler may be compressing packets to a greater degree then is correct. For example, the profiler 17 may have indicated to the compressor 15 that a field that had not changed for n packets is static, prompting the compressor 15 to compress that field accordingly, when subsequently the profiler 17 determines that the behaviour of that field has changed. Preferably, this change is signalled to the compressor 15 and de-compressor 16 immediately, to the de-compressor 16 using out-of band signalling or alternatively in-band signalling. For example, a profile update may be encoded as a number of additional bytes that are attached to a compressed packet sent to the mobile station 12. The same update may be persistently attached to different compressed packets until acknowledgement that the update has reached the compressor 15 is received.

Additionally, multiple types of encoding may be associated with a single field, to allow the profiler 17 to identify new types of field behaviour without necessarily

overriding previously seen behaviour patterns. In order to allow the compressor 15 and de-compressor 16 to make use of this data, the profiler 17 may indicate to them the probabilities of the different encodings. Thus, for example, the profiler 17 may indicate that a field is static with high probability but has a small (non-zero) probability of changing. This should allow the compressor 15 and de-compressor 16 to manage slight deviations from expected behaviour without requiring large amounts of out-of band signalling.

In the above described example, it is assumed that the number of fields in each packet, their ordering, and the length of each field is known to the compressor 15 and the de-compressor 16, allowing the profiler 17 to analyse the packets on a field by field basis. In some instances, for example, if the communication involves a new data-type, associated with a new protocol stack, such information will not be available to these entities at connection set-up. In such instances, the profiler 17 is arranged to analyse received packets so as to identify behaviour patterns in equivalent sub-sections of the packets.

For example, as illustrated in Figure 5 each whole packet may be treated simply as a string of octets and the profiler 17 arranged to examine successive packets looking for correlation between equivalent octets in the packets. Thus, without trying to identify field boundaries, the profiler 17 profiles the packet behaviour over time on an octet by octet basis. For example, the profiler 17 identifies octets that retain the same value, or that rarely change, or that take on a small number of values. As described above with respect to field behaviour, each time the profiler 17 identifies a pattern in the behaviour of a given octet this information is encoded and passed to the compressor 15 and de-

compressor 16 which implement an appropriate compression/de-compression scheme accordingly.

As with the known field length example discussed above, throughout the duration of the call connection between the base station 11 and the mobile station 12, the profiler 17 continues to analyse the behaviour of the octets in order to update the profile at the compressor 15 and also at the de-compressor 16 as and when necessary.

It will be understood that profiling packet behaviour on an octet by octet basis is given by way of example only, and the profiler 17 could be configured to profile packet behaviour on the basis of packet sub-sections of any convenient size, for example 10 bits.

A further embodiment of the invention will now be described with reference to Figure 6, in which components already described with respect to Figure 2 are given similar reference numerals. In this embodiment, the profiler 17 rather than being located in the base station 11 is located in the mobile station 12. In operation, at connection set up, packets received at the base station 11 are initially transmitted to the mobile station 12 un-compressed. At the mobile station 12, the profiler 17 analyses received packets to determine the profile of the packets. As described above, if the frame format of the packets is known then the profiler 17 analyses the packets on a frame by frame basis. If the frame format is not known, then the profiler 17 analyses the packets on a sub-section by sub-section basis, for example octet by octet.

In either case, each time the profiler 17 determines the behaviour pattern of a given field or a given sub-section, this information is passed to the de-compressor 16 and is also transmitted from the mobile station 12 to the base station 11 where it is passed to the compressor 15. As in the examples described above, each time the profiler

17 notifies the compressor 15 of the behaviour of a given field or sub-section, the compressor is then able to use an appropriate compression technique for that field or sub-section in subsequent packets and the de-compressor is able to use an appropriate complementary de-compression technique on those packets when they are received. In this embodiment, the profiler 17 may be arranged to analyse received packets either before they are input to the de-compressor 16 or after they are output from the de-compressor 16.

A further embodiment of the invention is illustrated in Figure 7 in which features already described with respect to Figures 2 and 6 are again given similar reference numerals. In this embodiment, both the base station 11 and the mobile station 12 are provided with their own profiler, indicated as 17a and 17b respectively. In operation, packets received at the base station 11 from the internet 14 are, as described hereinbefore, analysed by the profiler 17a to develop a profile of the behaviour of either fields in the packet or sub-sections of the packets. As before, the information on the behaviour of each field or sub section developed by the profiler 17a is sent to the compressor 15 which then implements appropriate compression techniques. Advantageously, in this embodiment, there is no need for the information determined by the profiler 17a to be sent from the base station 11 over the wireless interface 13 to the mobile station 12 for passing to the de-compressor 16. Instead, the profiler 17b performs its own analysis on packets received from the base station 11, to develop its own profile of the behaviour of either fields in the packet or sub-sections of the packets, which matches that developed by the profiler 17a. The information on the behaviour of each field or sub-section developed by the profiler 17b is sent to the de-compressor 16

which then implements appropriate de-compression techniques that are complementary to the compression techniques applied at the compressor 15.

Again, the compressor 15 will initially implement a conservative compression scheme with the initial packets transmitted to the mobile station 12 not being compressed. As before, the compression scheme implemented by the compressor 15 will be enhanced and refined as and when the compressor 15 receives information from the profiler 17a detailing the behaviour of the fields (or the sub-sections) of the packets. Advantageously, since the information on the field (or sub-section) behaviour required by the de-compressor 16 in order to de-compress packets, is generated locally by the second profiler 17b there is no requirement for this information to be signalled from the base-station 11 to the mobile station 12, thereby saving on bandwidth usage. It will be appreciated by those possessed of the appropriate skills that the two profilers 17a and 17b must be kept operating in synchronisation. This may be achieved, for example, by transmitting a regular synchronisation signal from the base station 11 to the mobile station 12 on a dedicated control channel

It is to be understood that the invention has been described with reference to the Internet and a cellular mobile communications network for illustration only. The invention may find application in any communication system or combination of systems where it is desirable to compress data packets in a packet flow prior to the packets being received at a receiving station. For example, it is envisaged that the invention may find particular application in wireless local area networks.

Having thus described the present invention by reference to preferred embodiments it is to be well understood that the embodiments in question are exemplary only, and that modifications and variations such as will occur to those possessed of

appropriate knowledge and skills may be made without departure from the scope of the invention as defined in the appended claims.

Claims

1. A method of processing data packets in a data stream in a communication system, the method comprising:

receiving a plurality of data packets from the data stream;

analysing the plurality of data packets;

generating in response to the analysis, profile data which indicates how one or more parts of each of the plurality of data packets varies from data packet to data packet; and

making the profile data available so that a data packet compression scheme that accords with the profile data can be implemented on data packets in the data stream.

2. A method according to claim 1, the method further comprising:

sending the profile data to a compressor which implements the compression scheme on data packets in the data stream in the communications system.

3. A method according to claim 2, wherein the profile data is transmitted over a network link to the compressor.

4. A method according to any of claims 2 or 3, the method further comprising:

making the profile data available so that a data packet de-compression scheme that it is complementary to the data packet compression scheme can be implemented on packets in the data stream.

5. A method according to claim 4, the method further comprising:
sending the profile data to a de-compressor which implements the de-compression scheme in order de-compress packets in the data stream that have been compressed by the compressor.

6. A method according to claim 5, wherein the profile data is transmitted over a network link to the de-compressor

7. A method according to claim 6, wherein the profile data is transmitted over a wireless interface to the de-compressor.

8. A method according to claim 6 or 7, wherein the profile data is encoded as a bit string and attached to a data packet for transmission to the de-compressor.

9. A method according to any preceding claim wherein the plurality of packets are analysed such that the profile data indicates how one or more frames of the packets varies from packet to packet.

10. A method according to claim 9 wherein the one or more frames are header frames.

11. A method according to any of claims 1 to 8 wherein the plurality of packets are analysed such that the profile data indicates how one or more sub-sections a predefined number of bits long of each packet varies from packet to packet.

12. A computer programme for implementing the method of claim 1 when executed on a processor.

13. An apparatus for processing data packets in a communication system, the apparatus comprising:
means for receiving a plurality of data packets;
means for analysing the plurality of data packets;
means for generating in response to the analysis, profile data which indicates how one or more parts of each of the plurality of packets varies from data packet to data packet; and
means for making the profile data available for use in selecting a data packet compression scheme that accords with the profile data.

14. A system of processing data packets in a data stream in a communication network, the system comprising:
receiving a plurality of data packets in the data stream;
analysing the plurality of data packets to generate behaviour data that indicates how at least a part of each of the plurality of packets behaves from data packet to data packet;

implementing a data packet compression scheme in accordance with the behaviour data on data packets in the data stream.

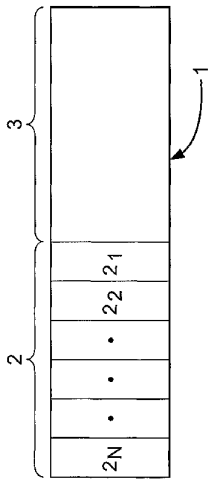


Fig. 1

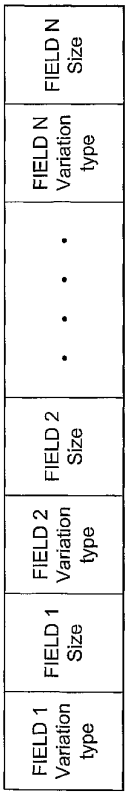


Fig. 4

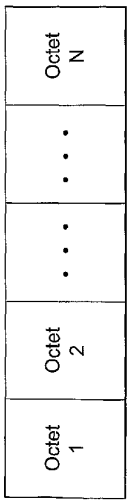


Fig. 5

Fig.2

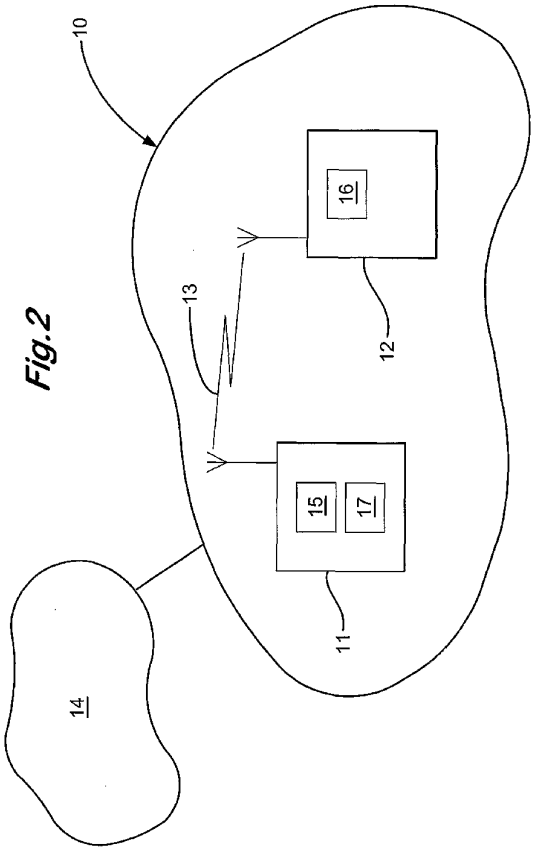
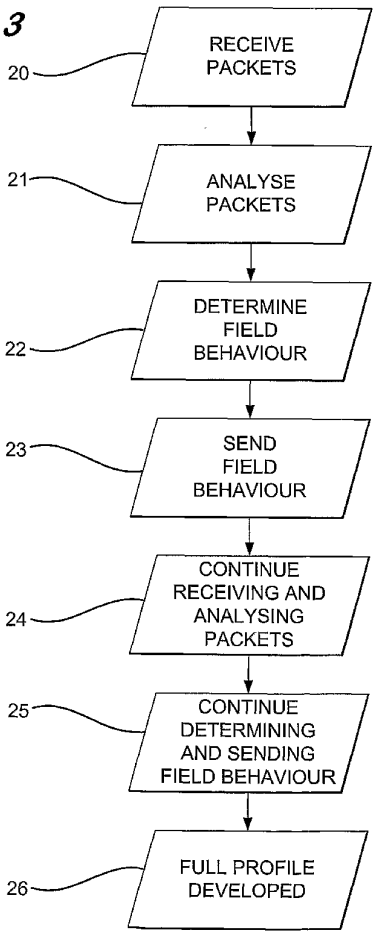


Fig.3


RECEIVE PACKETS
20
ANALYSE PACKETS
21
DETERMINE FIELD BEHAVIOUR
22
SEND FIELD BEHAVIOUR
23
CONTINUE RECEIVING AND ANALYSING PACKETS
24
CONTINUE DETERMINING AND SENDING FIELD BEHAVIOUR
25
FULL PROFILE DEVELOPED
26

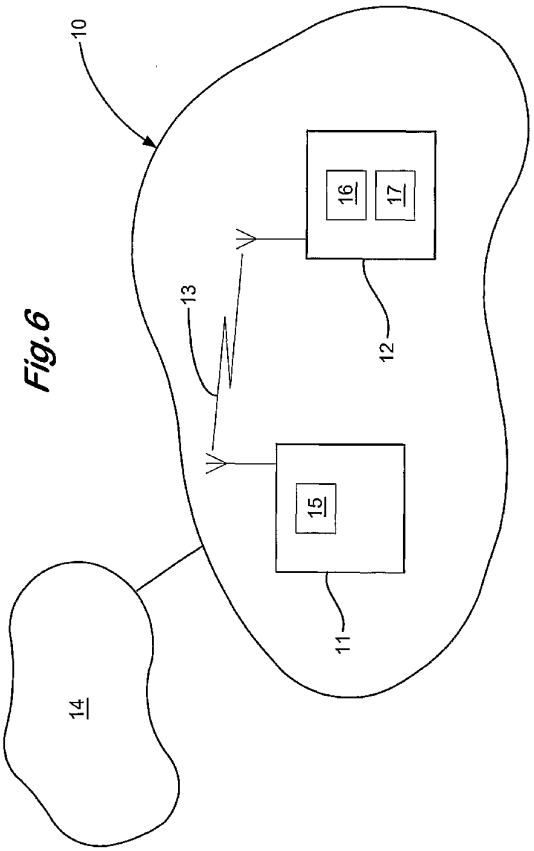


Fig.6

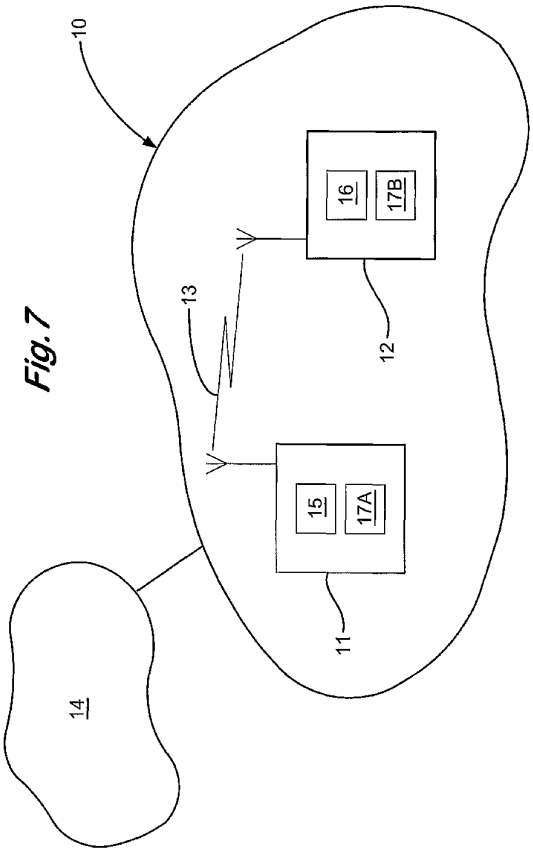


Fig.7

【国際調査報告】

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/04308

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 C08G61/12 A61K31/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 C08G A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	MCLEAN C D ET AL: "CYCLOPOLYMERIZATION. VI. PREPARATION AND PROPERTIES OF CROSSLINKED POLYAMINES BY CYCLOPOLYMERIZATION" JOURNAL OF MACROMOLECULAR SCIENCE: PART A - CHEMISTRY, MARCEL DEKKER, NEW YORK, NY, US, vol. A10, no. 5, 1976, pages 857-873, XP002068701 ISSN: 0022-233X page 865 page 868 ---	1
X	EP 0 296 622 A (HERCULES INC) 28 December 1988 (1988-12-28) claim 1 --- -/--	1

[X] Further documents are listed in the continuation of box C. [X] Patent family members are listed in annex.

° Special categories of cited documents :
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 October 2001	16/10/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Von Kuzenko, M

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/04308

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	BOLTO B A ET AL: "SYNTHESIS OF CROSS-LINKED POLYALLYLAMINES WHICH ARE RESISTANT TO SULFITE ATTACK" JOURNAL OF MACROMOLECULAR SCIENCE: PART A - CHEMISTRY, MARCEL DEKKER, NEW YORK, NY, US, vol. A17, no. 1, 1982, pages 153-166, XP002068702 ISSN: 0022-233X page 165 ---	1
X	JP 62 257481 A (SANYO CHEMICAL IND LTD) 10 November 1987 (1987-11-10) page 541 ---	1
X	PATENT ABSTRACTS OF JAPAN vol. 014, no. 132 (M-0948), 13 March 1990 (1990-03-13) & JP 02 001358 A (SANYO CHEM IND LTD), 5 January 1990 (1990-01-05) abstract ---	1
X	PATENT ABSTRACTS OF JAPAN vol. 006, no. 118 (C-111), 2 July 1982 (1982-07-02) & JP 57 047302 A (MITSUBISHI PETROCHEM CO LTD), 18 March 1982 (1982-03-18) abstract ---	1
X	US 3 957 699 A (SOLOMON DAVID HENRY ET AL) 18 May 1976 (1976-05-18) claims 1,6 -----	1

Form PCT/ISA/210 (continuation of second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 00/04308

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP 0296622	A	28-12-1988	US	4759923 A	26-07-1988
			EP	0296622 A2	28-12-1988
			JP	1022924 A	25-01-1989
JP 62257481	A	10-11-1987	NONE		
JP 02001358	A	05-01-1990	NONE		
JP 57047302	A	18-03-1982	NONE		
US 3957699	A	18-05-1976	AU	6917274 A	20-11-1975
			DE	2428096 A1	23-01-1975
			FR	2233336 A1	10-01-1975
			GB	1479664 A	13-07-1977
			JP	957167 C	14-06-1979
			JP	50035279 A	03-04-1975
			JP	53038754 B	17-10-1978
			NL	7407771 A	16-12-1974

Form PCT/ISA/210 (patent family annex) (July 1992)

フロントページの続き

(81)指定国 AP(GH,GM,KE,LS,MW,MZ,SD,SL,SZ,TZ,UG,ZW),EA(AM,AZ,BY,KG,KZ,MD,RU,TJ,TM),EP(AT,BE,CH,CY,DE,DK,ES,FI,FR,GB,GR,IE,IT,LU,MC,NL,PT,SE,TR),OA(BF,BJ,CF,CG,CI,CM,GA,GN,GQ,GW,ML,MR,NE,SN,TD,TG),AE,AG,AL,AM,AT,AU,AZ,BA,BB,BG,BR,BY,BZ,CA,CH,CN,CO,CR,CU,CZ,DE,DK,DM,DZ,EC,EE,ES,FI,GB,GD,GE,GH,GM,HR,HU,ID,IL,IN,IS,JP,KE,KG,KP,KR,KZ,LC,LK,LR,LS,LT,LU,LV,MA,MD,MG,MK,MN,MW,MX,MZ,NO,NZ,PH,PL,PT,RO,RU,SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,TZ,UA,UG,US,UZ,VN,YU,ZA,ZW

(72)発明者 ハンコック, ロバート
イギリス国 ハンプシャー エスオー１８ １エヌダブリュー サザンプトン ビターン・パーク リバー・ビュー・ロード ２２

Ｆターム(参考) 5K030 HA08 JL01 KA01
5K034 AA07 AA17 EE03 EE11 HH01 HH63